EXPERIMENTAL RESEARCH ON THE CONTROL OF A CNC AXIS ACTUATED THROUGH A STEP ENGINE

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During this research, the operation of the engine commanded with sequential strategies was studied. In this case MOV (021) commands are used which transfers a data word to the specific word and the ACC function (888) emits pulses to the specified output port at the specific frequency using the specified acceleration and acceleration speed. (The acceleration rate is the same as the deceleration rate.) It is possible to position independently or control the speed constantly. For positioning, ACC (888) is used in combination with PULS (886). ACC (888) can also be performed during pulse output to change the target frequency or acceleration / deceleration rate, allowing a smooth (sloping) change of speed

KEYWORDS: Stepper Motor, CNC Machine, PLC Programming, Microcontroller

1. Introduction

Recently, electric drive systems with stepper motors have developed more and more, due to the wide fields of use, but also due to technological advances in power electronics and microelectronics.

The most important areas of use are the peripheral and internal equipment of computers, such as printers, plotters, Floppy Disk, DVD RW, but also machine tools, robotics. Stepper motors (MPP) can be controlled by a numerical control in the open circuit due to increased accuracy and resolution.

The research focuses on the control of a numerically controlled axis driven by a stepper motor (MPP).

2. Current state of research

Technological developments in the field of electronics, especially mobile products, have led to the need for the emergence of machines for planting electronic parts on plates, those for automatic processing of metal parts, etc. Most of these machines are numerically controlled and contain high-precision moving parts. The operation of these machines is carried out with the help of DC motors, stepper motors, synchronous motors. Of these, stepper electric motors are the most common. DC motors have begun to be replaced by stepper electric motors (MPP) with the development of stepper motor control (MPP) techniques.

By sequentially supplying the motor phases with DC pulses, a discrete rotating magnetic field appears between the stator and the rotor. At the frequency guaranteed by the manufacturer, the rotor maintains its synchronism between the discrete movements and the discrete magnetic field in the air gap [2]. [3] . The electromagnetic torque of the stepper motor is triple [4], unlike that of the synchronous motor which is approximately constant. The rotational speed is given by the frequency of the voltage pulses applied to the phases in the case of the stepper motor. The electromotive voltage induced in the phases of the hybrid stepper motor, in the case of generator operation, is sinusoidal as in the case of synchronous motors. This is very important because the stepper motor with permanent magnets / hybrid can be modeled as a synchronous motor with permanent magnets with a number of pole pairs equal to the number of rotor teeth [5].

This research presents a classification of stepper motors, the components of a stepper motor and the open loop control of a CNC axis.

Fig. 1. Internal construction of a stepper motor (laboratory motor).

Fig. 2. Rotor of a hybrid stepper motor (laboratory motor).

3. Stepper motor classification

Because these engines have undergone a number of changes over time, a classification has been made according to the following criteria [1], [3]: by number of phases: Single phase MPP, Two-phase MPP, MPP with 3 or more phases,by rotor material and geometry: MPP with variable reluctance, MPP with permanent magnets, MPP hybrid, according to the shape of the rotor, MPP with disc rotor, MPP with cylindrical rotor by supply voltage type: MPP supplied with unipolar voltage, MPP powered by bipolar voltage.

4. Engine control system programming

Design and construction of an axle controlled by a stepper motor. In this research we will use a stepper motor that will be set in motion with the help of an OMROM CP1E controller, an MA860H driver and two inductive sensors to determine the **torque stroke**. Figure 3 shows the electrical connections.

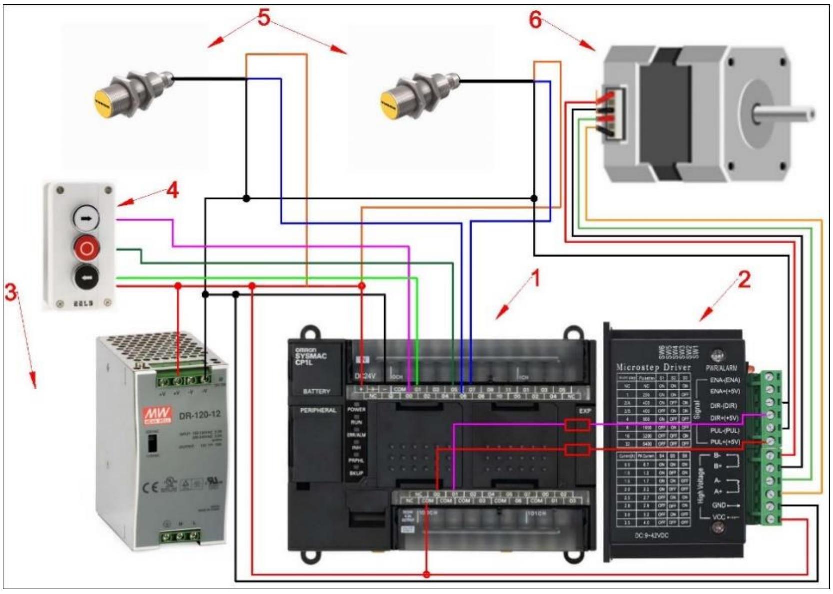

Fig. 3. Electrical connections

The components shown in figure 3 are: 1 -P LC, 2 - Stepper Motor Driver, 3 - Power Supply, 4 - Control Panel, 5 - Inductive Sensors, 6 - Stepper Motor.

As a first step, we use the CX ONE software from OMROM to develop the source code fig.4. After the source code is tested it will be transmitted to the PLC programmable controller.

The program used to operate the test platform highlights the cyclic movement of a mobile element operated by a stepper motor by means of a belt drive. The moving distance of the moving element is determined by two inductive sensors. The stepper motor operates after a well-defined cycle fig.5 with an acceleration and deceleration rate of 10 pulses at an interval of 10 ms until it reaches a target frequency of 4000 pulses. The program can be stopped at any time from the STOP button and resumed the cycle by pressing the left or right scroll button.

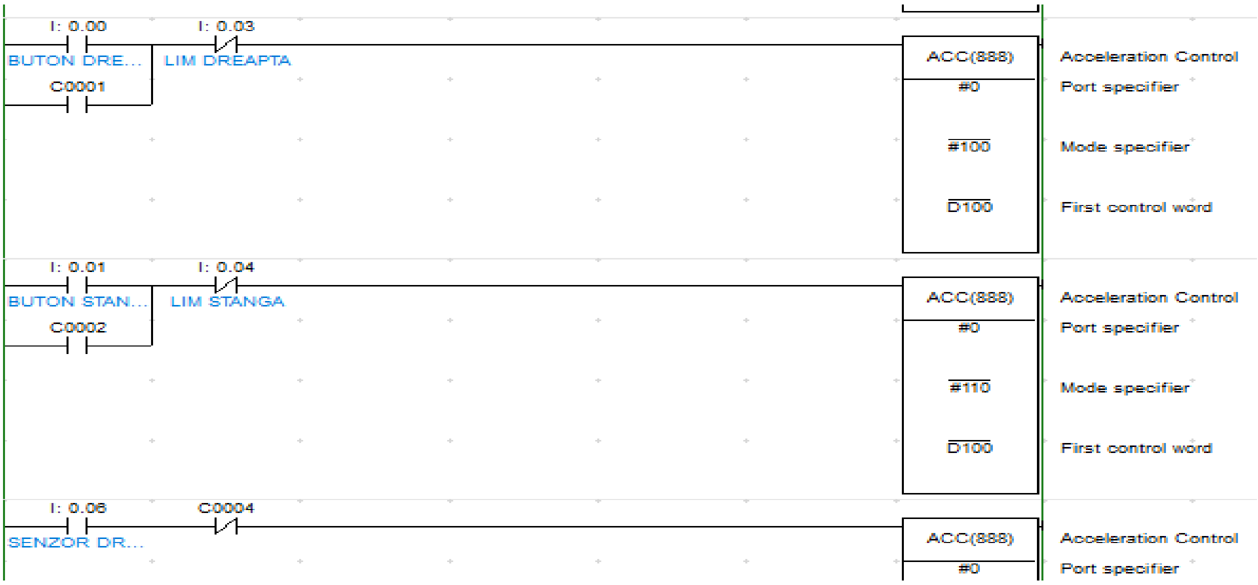

Fig. 4 Source code

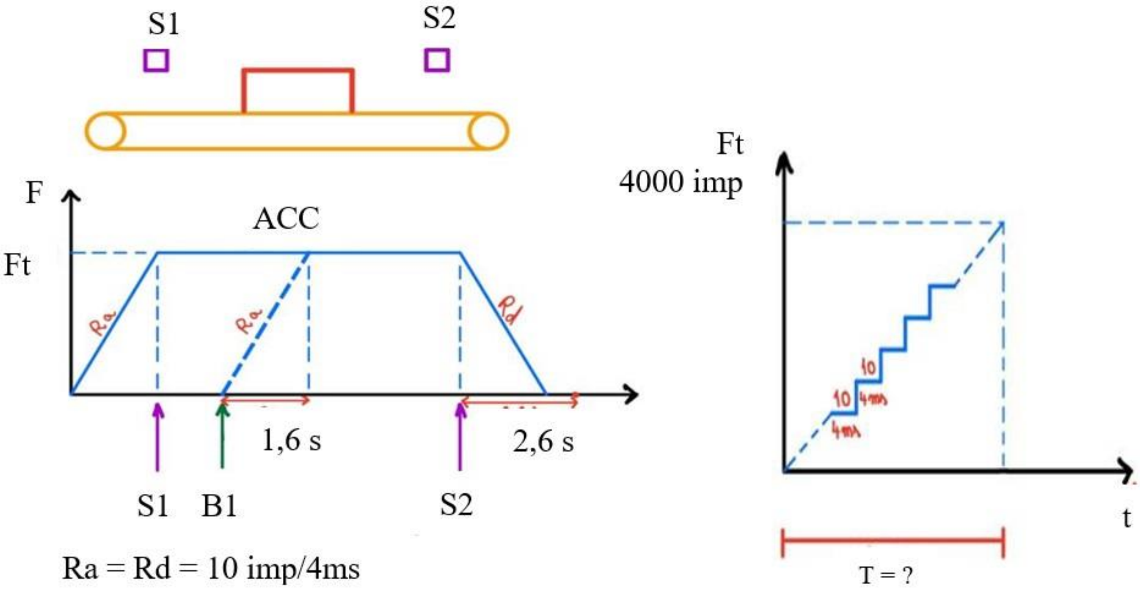

Fig. 5. Operation diagram

$$\frac{Ft}{Ra} = \frac{4000}{10} = 400\ imp$$

T =400 x 4=1600 ms = 1,6 s

When the B1 button is pressed, the ACC function starts to generate pulses with the acceleration rate Ra of 10 pulses every 4 milliseconds until the target frequency Ft is reached, this lasts 1.6 seconds, when the Ft frequency is reached, it continues its movement to the sensor S2 which triggers the deceleration with the same deceleration rate 10 imp / 4ms, after which it stops for a second and resumes the cycle in the opposite direction.

5. Starting and testing the platform

The start of the test platform can be achieved by means of three physical buttons B1 (start to the left), B2 (start to the right) and the STOP button that stops the platform regardless of its position (Figure 6).

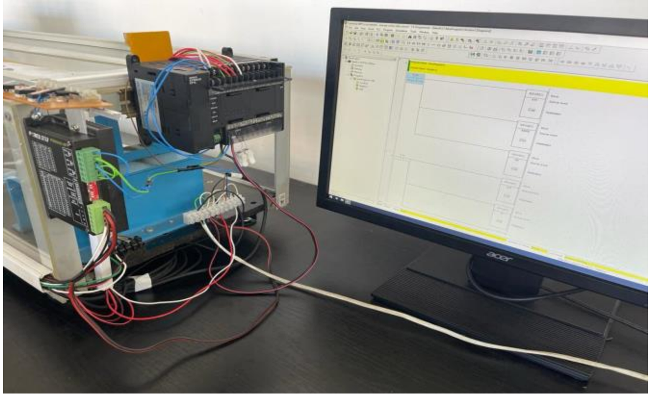

Fig. 6. Testing the platform

6. Conclusions

The construction of stepper motors has been described. A classification of these motors has been made according to several criteria such as: number of phases, geometric construction of the motor, rotor shape and polarity of the supply voltage. An open loop control study was performed. The electrical connections between the stepper motor, the driver and the OMROM controller were made.

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